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# Alwana oil: The traditional Amazigh olive oil of the Pre Rif (Northern Morocco)

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ABSTRACT

*Purpose of the research:* Alwana oil is a unconventional type of olive oil that has been prepared for centuries from roasted olives by women of Berber origin in the central Rif mountain. This study is aimed at documenting the information about alwana oil, an emerging ingredient of moroccan cuisine.
*Results:* Alwana oil has a good nutritional value and an interesting profile that should allow it to easily find its place in gourmet stores.
*Conclusions:* Alwana oil is a new type of oil that merits to find its place in the edible oil vast field. However, a special care must be taken to minimize polycyclic aromatic hydrocarbon formation during olive heating. Satisfactory polycyclic aromatic hydrocarbon levels will allow its export.

## Introduction

Local gastronomy (not to be confused with local food), which is also referred to as regional cuisine, is a specific type of cooking associated with a specific region-associated way of life. Local gastronomy is often cooked using ingredients whose preparation requires a know-how strictly transmitted within a restricted group of people often representing a whole country or an ethnic minority. Once local gastronomy is socially and culturally accepted by people living outside its original country, it becomes refer to as ethnic food (Karizaki, 2017). Therefore ethnic food can be defined as local gastronomy that would have gained international recognition. It is therefore very clear that wide international access to any ingredient necessary to prepare ethnic dishes is a prequisite for local gastronomy to take the plunge into ethnic food.

The Rif is the northern region of Morocco (Fig. 1). Over time, its inhabitants have developed a specific cuisine and traditional pharmacopoeia (Fakchich and Elachouri, 2014; Bachar et al., 2016). It is a mountainous area bordered by the Mediterranean Sea on the north and that extends up to the city limits of Oujda on the east. It is separated from the Middle Atlas on the south and the Atlantic Ocean on the west by fertile plains.

The Rif can be subdivided into three parts. The western Rif is covered with large mountains. It presents a mild climate with heavy rainfall during the winter. The central rif is a much more remote area. Conversely to the western Rif, which is principally an arabic-speaking area, central Rif is mainly a Amazigh-speaking area. It is also populated with *Jbala*, an ethnic group of arabic-speaking people of Amazigh origin (Maddy-Weitzman, 2015). Indeed, due to its ruggedness and remoteness that are both a consequence of a relief composed of very high mountains frequently snow-covered in winter until March-April, the central Rif, as other remote areas of Morocco, has for a long time attracted a fragment of the Amazigh (Berber) population. Nowadays, central Rif still shelters numerous descendants of Morocco's original inhabitants who predated the Romans and the Arab Muslim conquests in the 7th century. Hence, in central Rif, Imazighen (plural of Amazigh) compose a socially active ethnic group mainly characterized by matriarchal traditions (Aït Frawsen and Ukerdis, 2003). The eastern Rif is the flattest part of the Rif. It is populated with Amazigh or Arabic speakers.

Alwana oil is a major ingredient of central Rif cuisine. It is a unique type of olive oil prepared from overnight-roasted olive. Because of the international success of argan oil (Charrouf and Guillaume, 2010), an oil traditionally prepared by the fragment of the Amazigh population who took refuge in southern Morocco, alwana oil is currently planned to be internationally marketed with the underlying idea of making the recognition of central Rif food as an ethnic food. This paper reviews available information regarding traditional production methods, biochemical, nutritional, and safety properties of alwana oil in an effort to provide useful information to assure the safety of foods.

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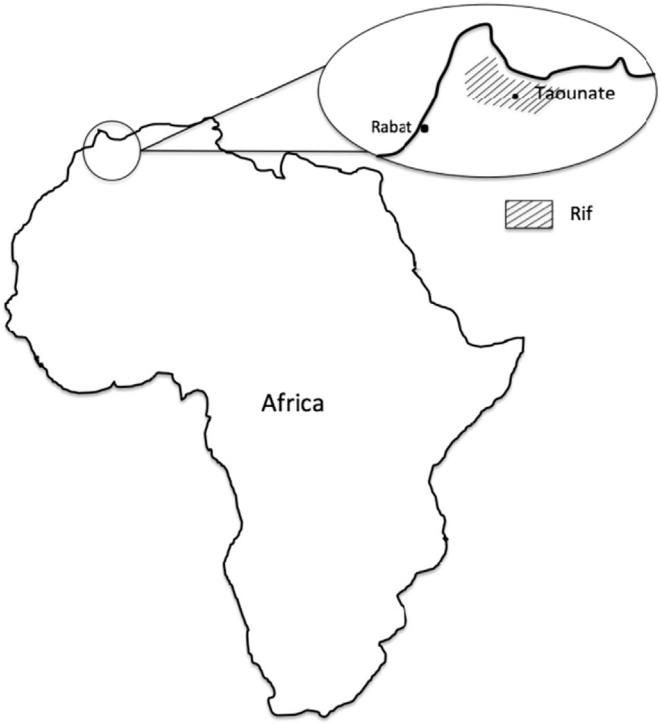


**Fig. 1.** Map of Africa showing the area of production of alwana oil within the Rif (Northern Morocco).

## Methods

Interviews of women and alwana oil producers were conducted by personal visits to Taounate, Ghafsai, and Ain Berda during which pictures were taken. Online database and scientific publications were also exhaustively investigated.

## Results and discussion

Originally considered as the quitessence of the mediterranean product, olive oil, which will be referred to "ordinary olive oil" in this paper, is nowadays produced worldwide. To ascertain its quality the International Olive Council (IOC) has published preparation standards that preclude the use of thermal conditions. However, heat-treatment of olive fruit is documented and has been recommended to reduce olive oil betterness (Garcia et al., 2001; Luaces et al., 2005). It must nevertheless be well noted that in this latter case, heating is moderate (40–60 °C) and limited to a few minutes. Consequently, alwana oil is a unconventional type of olive oil that is neither considered nor even mentionned by the IOC.

### *Preparation of alwana oil*

For cultural reasons, alwana oil has always and still is exclusively prepared by women, as is argan oil by the Southern Morocco Amazigh population (Charrouf and Guillaume, 2008). The first step of the alwana oil preparative process occurs between November and January when olive-fruit harvest is performed. Olive fruit is handpicked and the collected fruit consists of a mixed of almost-ripe greenish and fully-ripe purple fruit gathered from small olive trees or low branches of adult trees (Fig. 2) (El Alaoui, 2007; Aumeeruddy-Thomas and Caubet, 2017). Because of the gesture used to collect the olive fruit, in the Amazigh culture, this fruit picking step is named "olive-tree milking". Fruit is stored in large baskets (Fig. 2) then, in a second step, it is either spread in a heat-resistant dish or directly inserted in a hot outdoor bread oven, immediately after the baking of the family bread (Fig. 3). Olive fruit (generally about 5 kg) is then left overnight in the clay-sealed bread oven (Fig. 4). Heating results in the dehydration of olives that concomitantly turn dark-color. Interestingly heating gives alwana oil its specific smoky taste and will allow the subsequent production of an oil totally devoid of waste waters. Overnight heated olives can be possibly preserved for a while but generally, as soon as the fruits are taken out of the oven, the third step begins. Women in charge of alwana oil preparation quickly pour the olives in a large wicker tray (Fig. 5) and crush the still hot olives between two heavy stones: a flat one lying at the bottom of the tray and a second used to violently smash olives (Fig. 6). Smashing is performed for not less than 90 min and results in the production of a dough made of fruit pulp and broken nuts. The resulting paste is then ready for the fourth step during which the dough is mildly heated and hand-kneaded for 15 min while a minimum volume of hot water is added (Fig. 7). The dough is then poured into flat strainers made of vegetal matters. Most generally, strainers are made of rush sticks or palm leaf, two materials selected for their ability to retain little oil. Strainers are then placed into a press made of carob tree

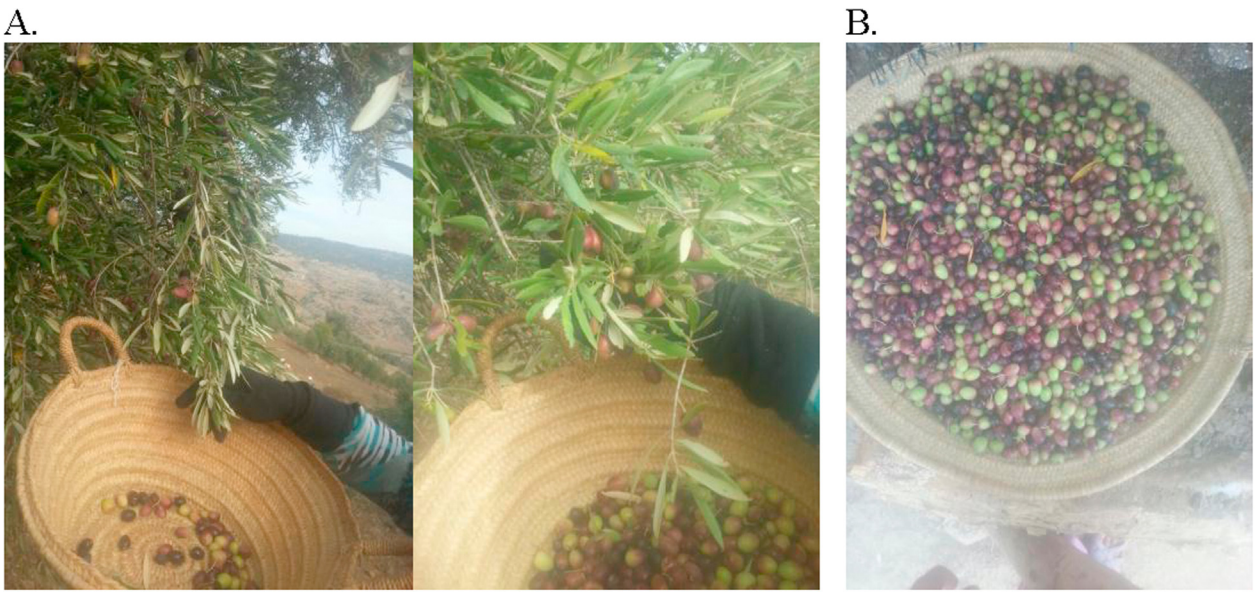


**Fig. 2. A.** Woman-achieved olive tree milking. Olive fruit is hand-picked and collected in large baskets. **B**. Olive fruit of different colors ready to be roasted.

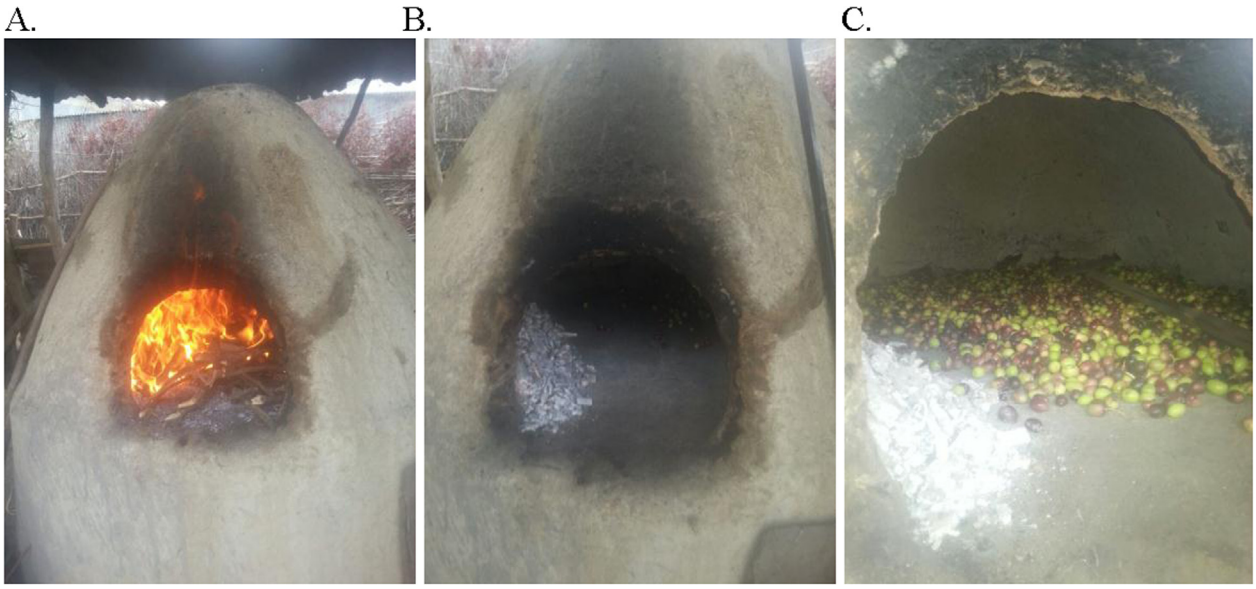


**Fig. 3. A**. Burning out-door oven. An intense fire is kept for several hours to warm the oven in which olive fruit will be placed overnight, together with hot ashes. **B**. Ash-containing out-door oven. Ashes are pushed back on one side to make room for olive fruit. **C.** Olive fruit is placed next to hot ashes in the oven.

**Fig. 4.** Once olive fruit is introduced in hot oven, next to ashes, oven is carefully sealed and olive fruit is left overnight.

(*Ceratonia siliqua*) wood (El Alaoui, 2007). Once the two plates of the press get progressively closer by tightening screws, pressure leads to the flowing of alwana oil that can be easily collected (Fig. 8). Then, the press is inclined for a while and the remaining oil flows by gravity. From 5 kg of olives, an average of 75 mL of oil can be obtained (El Alaoui, 2007), far less than the yields of ordinary olive oil.

*Factors favorably influencing the possible marketing of alwana oil*

Ordinary olive oil is generally considered as a tasty and healthy cooking ingredient. Consequently, a part from taste consideration, the immediate question regarding alwana oil expected from consumers can be: Is alwana oil as healthy as ordinary olive oil?

Ordinary olive oil high content in unsaturated fatty acids and phenolic compounds, particularly oleic acid and the couple oleuropein/hydroxytyrosol; respectively, is currently presented as participating in cardiovascular risk protection (Solà et al., 1997; Bulotta et al., 2014; Huang and Sumpio, 2008). Therefore the major question raised by consumers tempted by alwana oil could regard the fatty acid and phenolic compound composition of this new oil. For comparison purpose, we analyzed available data to the light of values

Fatty acid composition of alwana oil has been found to not only satisfy IOC (2012) recommendations in terms of fatty acid content but its major and minor fatty acid composition is similar to that of ordinarily prepared olive oil from the same batch of picholine fruit (Gharby et al., 2018). Therefore, the preparative process used for alwana oil neither significantly qualitatively nor quantitatively modify the fatty acid content of the resulting oil. In both oil types, oleic acid was found to represent 75% of the whole fatty acids and the pool of saturated and unsaturated fatty acids were found to be in similar quantity (13% and

**Fig. 5.** Once olive fruit has been heated overnight, it is transfered in a large wicker tray.

**Fig. 6. A.** Olives stored in large wicker tray waiting to be crushed. **B.** Woman crushing overnight heated olives with two stones.

**Fig. 7.** Hand-kneading of crushed olives. The task is achieved by women generally it lasted 15 min and a minimum amount of water is added to make the dough easier to malax.

**Fig. 8.** Press formed of two plates that get progressively closer by tightening screws. Pressure leads to the flowing of alwana oil. The press will be inclined to collect the remaining oil by gravity.

86%, respectively). Therefore, ordinary olive oil and alwana oil likely possess the same fatty acid-associated pharmacological properties since neither heating (the most likely suspect) nor any of the other preparative steps used to get alwana oil modify its fatty acid composition. Regarding polyphenols, the second class of pharmacologically active compounds present in olive oil, they were found to be in slightly but significantly higher quantity in alwana oil than in ordinary olive oil (239 ppm vs 226 ppm). This high content in polyphenols in alwana oil likely results from the preservation within alwana oil of an amount of polyphenols that get discarded in waste waters, in ordinary prepared olive oil. Indeed, heat-induced removal of water in olive fruit during alwana oil preparation lead to the preservation of the whole polyphenol pool in the fruit even though some unknown amount of polyphenol is likely to be lost during heating. Regretfully, no precise data are presently available regarding oleuropein and hydroxytyrosol content. Tocopherols are natural molecules found in vegetable oils presenting vitamin E-like and antioxidant properties (Carpenter, 1979). Tocopherol content in alwana oil has been investigated (Gharby et al., 2018). Similar levels of α- and δ-tocopherol were found in alwana and ordinary olive oil. Nevertheless, and for a unknown reason, alwana oil is richer in γ-tocopherol that ordinary oil (Gharby et al., 2018). Phytosterols are another class of natural products that have been shown to be pharmacologically interesting oil constituents (Jones and Abu Mweis, 2009). Phytosterol content of alwana oil has been shown to be similar to that of ordinary olive oil (Gharby et al., 2018). Altogether, these data suggest that alwana and ordinary olive oil should share a similar pharmacological profile.

Olive heating during alwana oil preparation results in the elimination of mill waste water. Accordingly, alwana oil presents a moisture content of 0.08% (Gharby et al., 2018), a value much lower than that 0.2% required by the IOC for ordinary olive oil (IOC, 2012). Such low value is of interest and represents an important quality factor for the marketing of alwana oil since excess of water in olive oil is responsible for “veiling”: the formation and persistence of a suspended and dispersed material in olive oil that is not attractive to the consumer (Lercker et al., 1994).

The limited amount of moisture found in alwana oil is also important to ensure its prolonged preservation. Indeed, alwana oil was measured under an accelerated aging process, and its oxidation stability index was determined to be 34 h. Such satisfactory value is very similar to that observed for high quality argan oil (Gharby et al., 2011). This good preservation performance is another factor that could favorably influence its marketing.

Olive oil acidity is another essential quality factor that is used by the IOC to differentiate extra virgin, virgin and ordinary olive oil (IOC, 2012). Prolonged heating of olive fruit during alwana oil preparation could have been anticipated as a factor possibly leading to major triglyceride hydrolysis. Excessive hydrolysis should be witnessed by an elevated acidity value. Alwana oil acidity has been found to be 0.21%, a low value well below the 0.8% required by the IOC for the extra virgin olive oil label (IOC, 2012). Triglyceride hydrolysis can result from a simple chemical process or be enzymatically performed. Dehydration and chemical hydrolysis are two competitive phenomena that can possibly occur during olive heating. If triglyceride hydrolysis results from a simple chemical process, the low acid value observed for alwana oil indicates that dehydration of olive fruit occurs sufficiently quickly to prevent abundant triglyceride hydrolysis. If triglyceride hydrolysis is enzymatically performed, the low acid value observed for alwana oil indicates that heating olives leads to a quick enzyme denaturation and consequently to the preservation of alwana oil triglycerides.

*Factors detrimental for the possible marketing of alwana oil*

Despite all these favorable factors, some possibly detrimental data have been reported for the marketing of alwana oil. Particularly,

alwana oil displays an elevated content in secondary oxidation products. In ordinary temperature conditions, oxidation of fatty acids occurs via a free radical chain mechanism (Kim and Min, 2006) that is a slow process whose evolutive progress needs three steps that can be sequentially followed in the Laboratory by the determination of the oil peroxide value, then its UV absorption at 232, and at 270 nm. Heating or presence of metal can modify the kinetic of the oxidative process (Choe and Min, 2006). Alwana oil presents a very low peroxide value (Gharby et al., 2018) meaning that side chains of fatty acids present in alwana oil triglycerides are not excessively oxidized. Alwana oil also displays a low content in primary oxidation products characterized by its low absorption at 232 nm (Gharby et al., 2018). However, its content in secondary oxidation products is high as witnessed by its high absorption at 270 nm that reaches 0.32 (Gharby et al., 2018). For information the maximum value accepted for ordinary olive oil is 0.20 (IOC, 2012). This indicates that prolonged heating of olives has induced accelerated and non-specific oxidative reactions of the unsaturated fatty acid leading to the accumulation of highly oxidized ketone- or aldehyde-containing molecules. Such molecules are known to possibly induce health concerns in case of prolonged consumption (Addis and Warner, 1991).

The second problem associated with alwana oil is possible the presence of elevated amounts of polycyclic aromatic hydrocarbons (PAH) (Gharby et al., 2018). This study has shown a level for these compounds to be ten times higher than that encountered in ordinary olive oil. Such level surpasses the concentrations authorized in the European Community (2002). It is of course necessary to confirm this high level of PAH on several alwana oil samples to ascertain that it is a problem inherent to the preparative process or simply associated to a specific preparative batch.

## Conclusion

Because of its nutritional value and its unconventional taste, alwana oil that reprensents the basic ingredient of the Rif-cuisine, presents a promising profile to become a product sought by gourmets. However, due to its method of preparation that is very artisanal and rudimentary, it can not be marketed worldwide, as it is, Indeed, its preparative process should be improved and norms should established to limit the temperature or the time of dehydration in order to eliminate undesirable compounds formed during prolonged heating. This problem needs to be tackled rapidly and on a repetitive as well industrial scale before to envision the large scale marketing of alwana oil.

## Acknowlegments

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## References

Addis, P.B., Warner, G.J., 1991. The potential health aspects of lipid oxidation products in food. In: Aruoma, O.I., Halliwell, B. (Eds.), Free Radicals and Food Additives. Taylor and Francis Ltd., London, U.K., pp. 77–119.
Aït Frawsen, U., Ukerdis, H., 2003. The origins of Amazigh women's power in North Africa. An historical overview. Al-Raida 20, 17–23.
Aumeeruddy-Thomas, Y., Caubet, D., 2017. Savoirs paysans autour des huiles d'olive, (zaytun, Olea europea var. europea) et d'oléastre, (el-berri, olea europea var sylvestris) Rif, nord du Maroc. Revue d'éthnoécologie. Supp. 1.
Bachar, M., Zidane, L., Rochdi, A., 2016. Ethno-medicinal and traditional phytotherapy of plants used in Bouhachem natural regional park "Rif of Morocco"- case of Tazroute district. J. Mater. Environ. Sci. 7, 4175–4204.
Bulotta, S., Celano, M., Lepore, S.M., Montalcini, T., Pujia, A., Russo, D., 2014. Beneficial effects of the olive oil phenolic components oleuropein and hydroxytyrosol: focus on protection against cardiovascular and metabolic diseases. J. Transl. Med. 12, 219–227.
Carpenter, A.P., 1979. Determination of tocopherols in vegetable oils. J. Am. Oil Chem. Soc. 56, 668–671.
Charrouf, Z., Guillaume, D., 2008. Argan oil, functional food, and the sustainable development of the argan forest. Nat. Prod. Commun. 3, 283–288.
Charrouf, Z., Guillaume, D., 2010. Should the amazigh diet (regular and moderate argan-oil consumption) have a beneficial impact on human health? Crit. Rev. Food Sci. Nutr. 50, 473–477.
Choe, E., Min, D.B., 2006. Mechanisms and factors for edible oil oxidation. Compr. Rev. Food Sci. Food Saf. 4, 169–186.
El Alaoui, N., 2007. Une presse à huile au Maroc. Tech. Cult. 48–49, 189–218.
European Commission, 2002. Opinion of the Scientific Committee on Food on the Risks to Human Health of Polycyclic Aromatic Hydrocarbons. Health and Consumer Protection Directorate General, Bruxelles, Belgium.
Fakchich, J., Elachouri, M., 2014. Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. J. Ethnopharmacol. 154, 76–87.
Garcia, J.M., Yousfi, K., Mateos, R., Olmo, M., Cert, A., 2001. Reduction of bitterness by heating of olive (*Olea europea*) fruits. J. Agric. Food Chem. 49, 4231–4235.
Gharby, S., Harhar, H., Guillaume, D., Haddad, A., Matthäus, B., Charrouf, Z., 2011. Oxidative stability of edible argan oil: a two year study. LWT- Food Sci. Technol. 44, 1–8.
Gharby, S., Harhar, H., Farssi, M., Ait Taleb, A., Guillaume, D., Laknifli, A., 2018. Influence of roasting olive fruit on the chemical composition and polycyclic aromatic hydrocarbon content of olive oil. OCL 25, A303.
Huang, C., Sumpio, B.E., 2008. Olive oil, the mediterranean diet, and cardiovascular health. J. Am. Coll. Surg. 207, 407–416.
IOC, International Olive Council, 2012. International trade standard applying to olive oils and olive-pomace oils international trade standard applying to olive oils and olive-pomace oils (p. 17).
Jones, P.J.H., Abu Mweis, S., 2009. Phytosterols as functional food ingredients: linkages to cardiovascular disease and cancer. Curr. Opin. Clin. Nutr. Metabol. Care 12, 147–151.
Karizaki, V.M., 2017. Iranian dates and ethnic date-based products. J. Ethn. Foods 4, 204–209.
Kim, H.J., Min, D.B., 2006. Chemistry of lipid oxidation. In: Akoh, C.C., Min, D.B. (Eds.), Food Lipids: Chemistry, Nutrition, and Biotechnology, Third edition. CRC Press, Taylor and Francis Group, Boca Raton, Fl, pp. 299–319.
Lercker, G., Frega, N., Bocci, F., Servidio, G., 1994. "Veiled" extra- virgin olive oils: dispersion response related to olive quality. J. Am. Oil Chem. Soc. 71, 657–658.
Luaces, P., Pérez, A.G., Garcia, J.M., Sanz, C., 2005. Effects of heat-treatments of olive fruits on pigment composition of virgin olive oil. Food Chem. 90, 169–174.
Maddy-Weitzman, B., 2015. Berbers (Amazigh). In: The Wiley Blackwell Encyclopedia of Race, Ethnicity, and Nationalism, pp. 1–3.
Solà, R., La Ville, A.E., Richard, J.L., Motta, C., Bargalló, M.T., Girona, J., Masana, L., Jacotot, B., 1997. Oleic acid rich diet protects against the oxidative modification of high density lipoprotein. Free Radic. Biol. Med. 22, 1037–1045.